argon gas is substituted for the C_2F_6/Ar in order to form etchant species that are also directed at a relatively steep angle 80 and subsequently at a relatively shallow angle 82 to form notches 84 in the P1 pole 14 as is depicted in Fig. 4.

Significantly, the use of C_2F_6 as an etchant gas creates fewer organic polymer contaminants than are seen with the prior art CHF_3 etchant gas. Thus, reduced cleaning and maintenance of tooling hardware is required. Additionally, it has been unexpectedly found that exposing NiFe to fluorine ion containing species, such as those generated in the C_2F_6 gas chemistry results in the formation of a beneficial Ni fluoride compound thin film layer on the surface of the P2 pole tip. Specifically, the Ni fluoride thin film 86 on the surface of the P2 pole tip apparently provides a protective layer that is more slowly etched by the argon etchant species than an unprotected NiFe P2 pole tip. This is in contrast to that which is found in the prior art CHF_3 etchant gas process, in which a polymer layer is formed to slow down the NiFe etching. Thus, the use of the C_2F_6 etchant gas also provides some protection for the P2 pole tip during the second step of the P1 layer notching with the argon etchant gas species.

a1

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There are two objectives in the write gap layer etching step; the first objective is to remove the write gap layer material, and the second objective is to remove any write gap layer redeposition material that is accumulated on the sidewalls of the P2 pole tip. As shown in Fig. 3, for write gap layer material removal, the incident angle i from the normal to the substrate surface of the C_2F_6/Ar beam is selected to be greater than the P2 pole slanting angle s, from the normal to the substrate surface. As is known to those skilled in the art, the angle s results from the P2 pole plating process conditions. Thus, where angle i is greater than angle s the shadowing of the P2 pole base by the P2 pole top is avoided. For example, if the slanting angle s is 5°, the

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